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GROUP 3700

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 08/895,936
Filing Date: July 17, 1997
Appellant(s): WISNIEWSKI et al.

Brett M. Hutton
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed June 14, 2004.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

This is one of four related appeals that the Board is urged to take up simultaneously. These four appealed applications are: SN 08/895,936, SN 10/057,610, SN 09/881,909 and SN 10/056,237.

(3) Status of Claims

The statement of the status of the claims at the time of final office action is correctly reproduced at the top of page 7 of the Brief.

(4) Status of Amendments After Final

The statement of the status of the claims contained in the Brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is deficient because it does not reference any portion of the specification nor make any reference to any drawing or reference numerals.

Figures 1 and 2 constitute the elected species and are described on page 10, line 7 through page 12, line 16 of the specification, which is incorporated here by reference.

(6) Issues

The appellant's statement of the issues in the brief is substantially correct. The changes are as follows: Issue 4 is an issue that the Board of Appeals has no jurisdiction over. The P.T.O. does not decide such matters.

(7) Grouping of Claims

The appellant's statement in the brief that certain claims do not stand or fall together is not agreed with because as to Group I (claims 90 and 121), these claims are withdrawn at present and not active claims subject to this appeal. Likewise, Group II (claim 91), Group III (claim 99), Group IV (claim 95) are all currently withdrawn and not active claims subject to this appeal. Finally, Group V (claims 101 and 111) are active claims in this appeal and are separately argued beginning on page 35 of the Brief.

Appellant's brief includes a statement that claims 101 and 111 do not stand or fall together and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

It is understood that appealed claims 88, 89, 96, 105-110. 112-116, 118 and 119 stand or fall together, as a first group, based on Appellant's grouping. Appealed claims 101 and 111 stand or fall together as a separate group. As to the first group, the only independent claims are claims 88 and 108.

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

The following is a listing of the prior art of record relied upon in the rejection of claims under appeal.

"Large-Scale Freezing and Thawing of Biopharmaceutical Drug Product," Richard Wisniewski and Vincent Wu, (both employed at Genentech) Proceedings of the International Congress, Advanced Technologies for Manufacturing of Aseptic & Terminally Sterilized Pharmaceuticals & Biopharmaceuticals, Basel, Switzerland, 17-19 February 1992, Convention Center Basel, pp 132-139.

3,550,393	Euwema	12/1970
5,535,598	Cothern et al.	07/1996

"Studies of Heat Transfer From a Vertical Cylinder, With or Without Fins, embedded in a Solid Phase Change Medium," B. Kalhori and S. Ramadhyani, Transactions of the ASME, Journal of Heat Transfer, Vol. 107, February 1985 pp. 44-51.

983,466	Voorhees	2/1911
3,318,105	Burroughs et al	5/1967
2,129,572	Finnegan	9/1938
1,874,578	Morrison	8/1932
JP 57-58087	Nakao	4/1982

2,114,642	West	4/1938
2,915,292	Gross	12/1959
2,391,876	Brown	1/1946

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 88, 89, 96, 101, 105-116, 118, and 119 are rejected under 35 U.S.C. 112, second paragraph. This rejection is set forth in a prior Office Action, mailed on 02/24/2004 beginning on page 21.

Claims 88, 89, 96, 105, 108-110, 112-115, 118 and 119 are rejected under 35 U.S.C. 102(b) or, in the alternative, under 35 U.S.C. 103(a). This rejection is set forth in a prior Office Action, mailed on 02/24/2004, beginning on page 26.

Claims 88, 89, 96, 105, 108-110, 112-115, 118 and 119 are rejected under 35 U.S.C. 103(a). This rejection is set forth in a prior Office Action, mailed on 02/24/2004, beginning on page 32.

Claims 88 and 89 are rejected under 35 U.S.C. 103(a). This rejection is set forth in a prior Office Action, mailed on 02/24/2004, beginning at the top of page 36

This rejection is <u>withdrawn</u> by the Examiner as being unnecessary given the current grouping of the claims.

Claims 96, 105-110, 112-115, 118 and 119 are rejected under 35 U.S.C. 103(a). This rejection is set forth in a prior Office Action, mailed on 02/24/2004 beginning below the middle of page 36.

Claims 96, 105-110, 112-115, 118 and 119 are rejected under 35 U.S.C. 103(a). This rejection is set forth in a prior Office Action, mailed on 02/24/2004, at the bottom of page 43.

Claims 96, 105-110, 112-115, 118 and 119 are rejected under 35 U.S.C. 103(a). This rejection is set forth in a prior Office Action, mailed on 02/24/2004, beginning on page 47.

Claims 101, 111 and 116 are rejected under 35 U.S.C. 103(a). This rejection is set forth in a prior Office Action, mailed on 02/24/2004, beginning on page 48.

(11) Response to Argument

Appellant's arguments begin on page 8 of the Brief and they are addressed here in the same order presented there:

A.1. "Biopharmaceutical Product"

In view of the explanation found on page 11, first paragraph of the Brief, this rejection is withdrawn. Appellant has explained clearly, for the first time, what the Examiner perceived to be an inconsistency between the specification with regard to "buffers" and the definition offered by declarants Burman, Lawlis and Vetterlein.

Notwithstanding that the term "biopharmaceutical" is definite, the Examiner is not persuaded by the argument that orange juice, milk, water and comestibles do not exhibit some of the same processing concerns as biopharmaceutical products. Other than opinion evidence, there doesn't appear to be any scientific evidence that this statement by Appellants is valid. In the course of prosecution, Appellants have submitted many prior art references for consideration, by the various examiners involved, related to

freeze concentration of food products. It is submitted that if this were unrelated art, as Appellants now contend, it would not have been produced by Appellants for consideration during prosecution. Moreover, much of this prior art related to freeze concentration of food products appears in the Appendices of the 1996 Wisniewski and Wu prior art, ample evidence that Appellants perceived food freezing prior art to be relevant to their invention, before the taking of this Appeal. As well, much of the prior art relief upon in the rejections discusses the problems of attaining uniform freezing of liquid food products (such as West 2,114,642), not unlike those that Appellants have encountered in processing biopharmaceuticals. Finally, it is extremely well known in the heat transfer art that scientists routinely makes heat transfer measurements in one material that can be extrapolated to other materials by known correlations, such as Reynolds number, Prandtl number and Nusselt number. There is in the record before the Board no objective evidence (e.g. test results etc.) demonstrating that the freezing biopharmaceuticals is unique compared to other mixtures of organic cellular products such as orange juice or ice cream.

2. <u>Thermal Bridge</u>

In this section of the Brief (spanning pages 12-19), it is argued that the term "thermal bridge" is both definite and that it is not disclosed in the prior art (the 1992 Wisniewski and Wu article).

With respect to definiteness, the term "thermal bridge," is, in light of Appellants' explanation that it must be read in conjunction with the remainder of the limitations in

the last paragraphs of claims 88 and 108 respectively, definite and the 35 U.S.C. 112, second paragraph rejection, is withdrawn.

With respect to the second argument (relying largely on Mr. Wisniewski's first and second declarations), that a "thermal bridge" does not form in the 1992 Wisniewski and Wu prior art, the Examiner maintains that it is wrong. As stated many times previously, Mr. Wisniewski has all the means at his disposal to test whether a thermal bridge forms in the 1992 Wisniewski and Wu prior art and he steadfastly refuses to do so (relying instead on his opinion, where the art is such that opinion evidence is of little value given that the heat transfer processes are too complex to make such sweeping predictions of actual temperature distributions within the freezing fluid, as Mr. Wisniewski purports to do in his declarations). The reader is referred to pages 6-15 of the final rejection for the Examiner's analysis.

Addressing Appellant's Remarks on pages 14-17 of the Brief, the Examiner's critique is extremely simple. Essentially two things are wrong with Exhibits B-D of the first declaration of Mr. Wisniewski.

First, Mr. Wisniewski incorrectly assumes that the fluid (c) in the jacket and the heat exchanger immersed in the biopharmaceutical are at the same temperature. They are not in the 1992 Wisniewski and Wu prior art as a consequence of the coolant going through the jacket first (and absorbing heat) and then the warmed coolant (i.e. hotter coolant than the jacket) is piped to the centrally located heat exchanger. Furthermore, notwithstanding Mr. Wisniewski's statements to the contrary, there can be absolutely no doubt that, when the entire content of the tank is frozen, the downward gradient

temperature must exist between the tip of the fin and the interior wall of the container because the fluid going through the heat exchanger pipe is always warmer than the fluid going through the jacket. Thus, it is beyond dispute that once the entire contents of the tank are frozen, the warmer coolant in the centrally located heat exchange structure an the cooler coolant in the jacket will cause the thermal gradient to be downward from the tip of the fin towards the jacket wall (i.e. in the thermal bridge formed in the gap between these two structures). This has been made clear on the record, by a relatively simple mathematical analysis using Fourier's Law of heat conduction that is extremely predictable (once the contents are frozen and Fourier's Law of heat conduction applies) and Appellant has simply ignored it. See page 11 of the final rejection. By contrast Appellant purports, in his declarations, to predict temperature distributions in a partially frozen mass without any mathematical analysis or experimental data – an impossible task, given that the heat and mass transfer complexities are known to be beyond such "thought experiments" (as evidenced by the Kalhori and Ramadhyani article).

In so far as Figure 3b of the disclosure is concerned (Brief, page 14), this simply illustrates that if you wait long enough a downward gradient will occur. What Figure 3b does not illustrate is what happens right after the disclosed system starts up, which is more in keeping with what Exhibit B of the first Wisniewski declaration shows (i.e. before the ice has bridged). In other words, Appellant has engaged in a type of "apples to oranges" comparison in which the purported invention performance is shown at a time when the ice has bridged significantly (Figure 3b) and before the ice has bridged significantly in the case of Wisniewski Exhibits B and C of the first declaration pertaining

to the prior art. In so far as comparing the Exhibit D of the aforementioned declaration to Figure 3b of the specification (where ice has bridged significantly in both cases), the Examiner does not find the temperature profile <u>sketched</u> by Mr. Wisniewski for the prior art credible. The <u>fatal flaw</u>, as pointed out above, is Mr. Wisniewski's assumption that the fluid in the pipe forming the heat exchanger structure <u>is at the same temperature</u> as the temperature in the jacket of the prior art device. It is submitted that this is <u>never</u>, in fact, true. Because the jacket and heat exchange structure are serially connected with respect to coolant flow, the heat transferred in the jacket section will always change the temperature of the coolant flowing to the heat exchange section. In the case of cooling, the coolant in the heat exchange structure will always be warmer than the coolant in the jacket and, at <u>some point in time</u>, the downward gradient <u>must</u> form between the tip of the fin and the jacket wall as consequence of this temperature difference. Mr. Wisniewski's Exhibit B-D are not credible because the incorrectly assume both the temperature of the jacket and heat exchange structure to be equal. It is submitted that from erroneous assumptions follow erroneous conclusions.

If Mr. Wisniewski were to measure temperature profiles in his purportedly inventive device just after cooling was started of a room temperature batch of biopharmaceutical placed in it, it is submitted that the same type of gradient as shown in Exhibit B would exist as both the heat exchange fin and jacket wall absorbed heat quickly from the warm contents of the tank. By placing bigger fins on the heat exchange structure than were apparently used in the prior art, the inventors have merely made the downward temperature gradient shown in Figure 3b of the drawing Figures happen

<u>sooner</u> than in the prior art 1992 Wisniewski and Wu device. Putting bigger fins on heat exchanger and exchanging more heat is a fundamental tenet of the heat exchange art. Nothing novel or unobvious occurs. It is <u>inevitable however</u> that the downward temperature gradient will occur in the 1992 prior art, even with its apparently smaller fins (notwithstanding Mr. Wisniewski's first declaration, which would suggest otherwise), <u>at some point in time</u>. It <u>must</u> <u>occur</u> <u>at the very least</u> <u>once the entire contents of the tank</u> are frozen and in the Examiner's estimation before that time (depending on how close the fin tip is spaced from the jacket wall).

What the actual temperature profiles are in the contents of the tank between these two extremes (i.e. immediately after starting and once the contents are entirely frozen) the Examiner would not hazard to guess. The fluid phenomena and heat transfer equations are so complex it is submitted that no human being, including Mr. Wisniewski, could accurately model these profiles without either empirical data (i.e. test results) or high power computers. On this particular point, the Board does not have to trust the Examiner's opinion. The evidence is in the record - see the second paragraph of the Kalhori and Ramadhyani article, where they state the problems is so challenging as to be "amendable only to a numerical solution" (i.e. by computer). The Examiner is therefore very suspicious of the validity of Exhibits B-D of Mr. Wisniewski's first declaration given his admission that that no numerical techniques or experiments were used in their preparation. In effect, they amount to Mr. Wisniewski's guesses put in declarative form. Given the state of the art requiring numerical solutions, the Examiner can give Mr. Wisniewski's Exhibits B-D little weight except as "guesses" but in no way

definitive. Compounding the lack of experimental or numerical analysis, the boundary conditions (temperature of the jacket and heat transfer structure being the same) are clearly erroneous.

B. Prior Art under 35 U.S.C. 103(a)

Appellant argues that biopharmaceuticals are so different that none of the prior art relied upon by the Examiner can be relied upon (because materials other than biopharmaceuticals are being frozen). Given the number of different biopharmaceuticals Appellants have disclosed, the Examiner maintains all references related to freezing of food, comestibles and juice are relevant for the reasons stated in the final office action and at the beginning of this Examiner's Answer. Appellant, in an unlikely admission on page 20 of the Brief quotes the Examiner, with approval, suggesting that Mr. Wisniewski's Exhibits B-D of the first declaration cannot be credible. Contrary to the sentence spanning pages 20-21 of the Brief, the Exhibits B-D were not the product of experimental analysis or computer computation. They were by their own terms Mr. Wisniewski's "best of my knowledge" "reasonably resembles" guesses. There is no evidence they were experimental or generated with a computer (See Paper No. 33, page 12, lines 24-26). Moreover, how could they be, given that Mr. Wisniewski can't even remember the dimensions of the prior art device? How could he generate computer results, if he can't even remember how big the prior art device was? In Paper No. 33, page 12, lines 24-26, Appellant admits they are neither experimental nor computer generated and counsel is clearly in error when he suggests otherwise.

1. 102(b)/103(a) over 1992 Wisniewski and Wu article

Regarding the 35 U.S.C. 102(b) aspect that Examiner maintains that for the reasons already articulated above under the heading "Thermal Bridge" that the downward temperature gradient must occur in the prior art at some time after cooling is started and it can be demonstrated to occur by mathematical analysis using Fourier's law of heat conduction to occur once the entire contents of the tank are frozen.

In the paragraph spanning pages 24-25 of the Brief, Appellants appear to agree with the Examiner's drawings on page 30 of the final rejection. It is noted however that Appellant's have not commented upon page 13 of the final rejection where the examiner's analysis shows a "linear temperature drop through the ice" (i.e. Appellant's downward gradient). Implicitly, it is believed that have conceded the truth of the matter asserted by failing to show any flaw in the Examiner's analysis.

Regarding the 35 U.S.C. 103(a) aspect (Final Rejection, page 31-32), the Examiner maintains his reasons to increase the size of the fins to close proximity to the jacket in the 1992 Wisniewski and Wu prior art are sound as stated to advantageously increase the rate of heat transfer (not commented upon by Appellant) and to advantageously improve the division of the tank into compartments. Surely counsel is not arguing bigger fins would not form more distinct compartments, is he?

2. 103(a) 1992 Wisniewski and Wu article in view of Euwema, Cothern, the 1986 Kolhori and Ramadhyani article, Morrison and Nakao

All of these references, individually and taken in the aggregate, teach reasons for extending the fins in the 1992 Wisniewski and Wu article to a point close to the jacket wall. In support of this approach, see In re Gorman 18 USP2d 1885 (Fed. Cir. 1991) and In re GPAC 35USPQ2d 1116 (Fed. Cir. 1995).

Each of these references teaches extending fins mounted on a heat exchange structure to a point very close to the jacket or even in contact with the jacket of the tank, (as contemplated on page 13, lines 17-19 of Appellant's specification). Appellants attempt to assert that no "thermal bridge" will form in the 1992 Wisniewski an Wu prior art modified to have longer fins which extend to the jacket wall, or nearly so, as taught by five separate secondary references. This is not credible. Figure 3b of Appellant's disclosure demonstrates this will happen quickly, after start up, when the fins get large enough and close enough to the wall. All liquids freeze somewhat alike and a particularly dilute biopharmaceutical (e.g. a genetically engineered virus in an aqueous carrier) will freeze like the aqueous carrier. (e.g. saline, water etc.)

The Board should note that the 1986 Kalhori and Ramadyani article was cited to the Examiner by Appellants. If it is irrelevant, as is now argued because it doesn't pertain to biopharmaceuticals, why was it cited here and referenced in (Reference 29) in the 1992 Wisniewski and Wu article? Appellant's arguments are undermined by his own actions during the prosecution. Finall, there is "no different principle" of freezing in any of these references and this new argument has no factual basis in the record. Freezing is freezing (i.e. charging from liquid phase to solid phase). No one of ordinary skill would be so myopic as to ignore all prior art not specifically related to

biopharmaceuticals, as evidenced by Appellant's own actions during prosecution and by his own publications.

3. 103(a) 1992 Wisniewski and Wu article and 1986 Kalhori and Ramadhyani article.

Paraffin in an excellent substance to do heat transfer experiments on because of its well understood physical properties. The fact that it demonstrates how effective large fins (extending all the way to the tank periphery) are in improving heat transfer gets lost in counsel's analysis. It clearly shows that very large fins work extremely well as is recognized by Appellant on page 13, lines 17-19 of the specification. Again, the 1986 Kalhori and Ramadhyani article is explicitly mentioned as a reference relied upon in the Appendix of the 1992 Wisniewski and Wu article. If it is the irrelevant reference counsel now suggests, because of its failure to mention biopharmaceutical by name, then it wouldn't have been cited there and to the P.T.O. at the start of prosecution.

4. 103(a) the combined teachings of the 1992 Wisniewski and Wu article, the 1986 Kalhori and Ramadhyani Article; Euwema, Cothern, West, Morrison and Nakao.

a. West is relied upon here to teach a system remarkably close in structure to that disclosed by Appellants. Appellants with a cursory analysis suggest that there is no downward gradient in West because at the start both the central structure and jacket will

conduct heat from the liquid to be cooled. That same phenomena occurs in Appellant's purportly inventive device just after the cooling device is started, notwithstanding Appellant's seeming inability to acknowledge or comprehend that fact.

4. 103(a) further in review of conceded prior art discussed on page 1, line 22 – page 2, line 17 of the specification. (*sic*, page 2, line 1 – page 3, line 7).

While the Examiner had hoped a sketch would be forthcoming years ago, none has yet been prepared by Appellant, leaving it to the Examiner to "image" (July 14, 2003 amendment, page 3, first full paragraph), what such a device might look like. If the Board believes that it would be helpful to their decision they are invited to avail themselves of 37 CFR 1.196(d) to require its production. As for the Examiner's imagination, it is easy to "imagine" that this prior art looks very much like Appellant's Figure 1 of the disclosure. Nonetheless, such "imagination" amounts to no more than an invitation to speculation and the PTO strives not to decide cases based on speculative prior art. Regarding the assertion that the present invention does not contemplate "no gap" between the tip of the fin and the jacket wall, this appears to be contradicted by page 13, lines 17-19 of the specification. It is submitted in this later configuration that a "gap" could exist on <u>either side of the fin,</u> which is anchored to the jacket, notwithstanding Appellant's remarks to the contrary. Regarding footnote 9 at the bottom of page 35 of the Brief, imagination is no substitute for a sketch, which would show the relative dimensions of the structures and other details that words do not

convey. Moreover, as stated above, a gap could exist even where the fin contacts the jacket wall (i.e. in the open space(s) on either side of the fin.) The Examiner has strived repeatedly to get this information into the file and to the Board and accepts no responsibility for Appellant's failure to have it made of record in a way that would permit meaningful comparison.

5. <u>Claims 101, 111, and 116 further in view of Gross or Brown</u>

Appellant again reiterates that the Examiner is correct; that there is a "need" for the assistance of computer assistance to determine temperature distribution" seemly oblivious to the fact that the first declaration of Wisniewski (Exhibit B-D) was generated without computer assistance or experimental data given the fact that Mr. Wisniewski could not recall the relevant dimensions of the prior art 1992 Wisniewski and Wu device. Moreover, Appellant seems to be unable to reconcile the numerical sophistication required to predict temperature with the relatively simple observation that larger fins produce better heat transfer and better compartmentation and less cryo-concentration because of the faster cooling rates possible (all of these advantages explicitly recognized in the prior art relief upon by the examiner).

Brown and Gross are simply relied upon to show and teach a helical baffle in the tank jacket which has the effect improving heat exchange by distributing the jacket fluid all the way around the tank with no "short-circuiting" between the inlet and outlet.

c. Rule 56

The PTO does not decide Rule 56 compliance or non-compliance. Given the relevant dimensions (that are not of record) regarding the 1992 Wisniewski and Wu prior art, the examiner only made reasonable suggestions to Appellant as to how to obtain the information that was lacking (i.e. the dimensions of the prior art device, which are not of record). Telephoning Genentech and asking them if they could provide the dimensions does not seem onerous in any way. In the worse case scenario, they could simply refuse. Mr. Wisniewski has, at various times, stated he knew nothing more about the Genentech device that what he stated at that time, only to state new facts about the device in subsequent responses. The Examiner never made any "requirement" for Appellant to test anything contrary to counsel's assertions. The Examiner indicated that Exhibits B-D were extremely weak given that they were not test results nor generated by computer (Paper No. 32, page 3, line 12 – page 5, line 12). In Appellant's response to this (Paper No. 33, page 11, line 19 – page 12, line 14) there were no assertions that the results in Exhibits B-D were computer generated or actual test results. Appellant simply admitted that "these temperature profiles were created at the request of the Examiner for his understanding during a previous telephonic interview."

Appellant also clearly stated in that response (Paper No. 33, page 12, lines 24-26). "Therefore, Applicants have no way in which, and are not required, to obtain actual measured results or computer generated results of the 1992 Genentech container."

Contrast this last statement with the sentence spanning pages 20-21 of the Brief, to wit, "In contrast, the explanation, schematics and temperature distributions provided by Mr. Wisniewski accompanying the First [i.e. Exhibits B-D] and Second Wisniewski. Declarations were supported by experiments (e.g. see page 12 of the Specification)..." (emphasis supplied), which, latter statement, is simply not true. There are real credibility problems with Exhibits B-D of the first Wisniewski declaration as well as real problems with the assumptions made about the temperatures of the heat exchange structure and the jacket being identical in the 1992 Wisniewski and Wu prior art, which is, from a heat transfer viewpoint, an impossibility.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted

John K. Ford
Primary Examiner

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September 8, 2004

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Japanese Kokai Patent Application
No. Sho 57[1982]-58087

CONTAINER FOR HEAT ACCUMULATING AGENT

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UNITED STATES PATENT AND TRADEMARK OFFICE
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CONTAINER FOR HEAT ACCUMULATING AGENT

[Chikunetsuzai yoki]

Inventors:	Kozaburo Nakao and Hisao Takeda
Applicant:	Kyoritsu Yuki Kogyo Kenkyusho K.K.

[There are no amendments to this patent.]

Claims

1. A container for a heat accumulating agent, characterized by the fact that several sheets of metallic plates with good heat conductivity are intersected and inserted into a cylindrical container in which a heat accumulating agent composition is housed.

2. The container for a heat accumulating agent of Claim 1, characterized by the fact that several sheets of intersected metallic plates have a cross or multiblade shape on a horizontal section of the container.

3. The container for a heat accumulating agent of Claim 1 or 2, characterized by the fact that the metallic plates have a number of through holes.

Detailed explanation of the invention

The present invention pertains to a container for a heat accumulating agent into which several sheets of metallic plates are intersected and inserted.

In general, the sensible heat or latent heat of a substance is utilized for accumulating heat; however, application of a heat accumulating agent depends on whether the sensible heat is used or the latent heat is used. As heat accumulating agents using sensible heat, water, gravel, crushed stone, etc., are mentioned, and these heat accumulating agents are useful since they can be easily handled, have a large specific heat, and are inexpensive. However, their volume and weight are very large. This is a disadvantage.

On the contrary, as heat accumulating agents using latent heat, crystalline substances of inorganic hydrates, etc., are mentioned. For example, calcium hexahydride chloride, etc., are mentioned. Since they utilize a phase change such as melting at a fixed temperature, the temperature decrease of the heat accumulating agent due to heat radiation is small, and since the latent heat for a phase change such as melting is generally significant, heat can be compactly accumulated. However, if the temperature of these salts is gradually lowered from the melting state or vice versa, extracting heat at a prescribed temperature is delayed, causing a practical inconvenience. Also, since the temperature conduction and convection of a substance in layers is poor, heat radiation is difficult. Therefore, faster heat conduction is needed.

Accordingly, these inventors variously reviewed the above problems to improve heat conduction in layers, and as a result, the problems were found to be solvable by inserting a metal with good heat conductivity into a cylindrical container for housing a heat accumulating agent. In other words, the present invention is a container for a heat accumulating agent characterized by the fact that several sheets of metallic plates with good heat conductivity are intersected and inserted into a cylindrical container in which a heat accumulating agent composition is housed.

Next, the present invention is explained in detail by figures.

In the case of a heat accumulating agent 1 accumulating collected solar heat, it is housed in a cylindrical container 2, and for example, in a method using an air as a heat collecting medium, heated air 4 is transferred to a heat accumulating chamber to heat the container 2 for the heat accumulating agent. Then, in a conventional container (Figure 1) in which only the heat accumulating agent is housed, melting of the heat accumulating agent starts only at the part of the heat accumulating agent in contact with the container wall as a result of heat from the outer periphery of the container for the heat accumulating agent, and the melting is sequentially advances toward the center. However, a very long time is required to finally melt the entire agent

after the melting has advanced. In addition, if the heat accumulating agent in a melted state radiates heat and its temperature is lowered, since the heat conduction is poor, a distinctly nonuniform distribution of the temperature is generated, and for this reason, heat cannot be extracted at a fixed temperature. Thus, several sheets of metallic plates with good heat conductivity such as plates of iron, copper, aluminum, and magnesium are intersected with each other at about the center of a horizontal section of the container and are inserted into the container. For example, as shown in Figure 2, (A) shows two sheets of metallic plates 5 intersecting each other in a cross shape, and (B) shows three sheets of metallic plates 5 intersecting each other in a multiblade pattern with the blades at a 60° spacing. Clearly, four or more sheets of metallic plates can also be used; however, if the number of sheets is too large, the amount of heat accumulating agent housed is decreased, and the cost is also quite high in accordance with the kind of metal, which is not preferable. In the cases shown in Figures 2(A) and (B), the part in contact with the container wall is melted, and the metallic plates 5 are heated by heat transfer from the melted heat accumulating agent 3. Heat is also transferred to the heat accumulating agent in the vicinity of the metallic plates by the heated metallic plates 5, and the vicinity of the metallic plates is melted, so that complete melting is rapidly completed. At the same time, if heat is radiated from the melted heat accumulating agent, heat transfer is fast. Then, when the heat accumulating agent reaches its melting point, the metallic plates act like crystal nuclei, and the heat accumulating agent is crystallized, so heat can be uniformly discharged.

In order to further improve the heat transfer by further improving the convection of the melted heat accumulating agent, holes with a round shape, square shape, star shape, etc., are bored at an appropriate density in part or over all of the metallic plates. These patterns also meet the objective of the present invention (6 in both (A) and (B) of Figure 3).

Thus, melting at a time of heating and solidifying at a time of radiating are smoothly carried out, so that heat is stably exchanged. Thereby, the heat accumulation density is high, and utilization of the heat is very efficient.

Brief description of the figures

Figure 1 is a plan view showing a conventional container for a heat accumulating agent. Figure 2 shows an application example of the container for a heat accumulating agent of the present invention into which metallic plates are inserted. (A) is a plan view showing the use of two sheets of metallic plates, and (B) is a plan view showing the use of three sheets of metallic plates. Figure 3 shows an application example of metallic plates in which holes are bored. (A) shows round holes, and (B) shows square holes.

1 Heat accumulating agent

2 Container

3 Melted heat accumulating agent
4 Hot air
5 Metallic plate
6 Hole

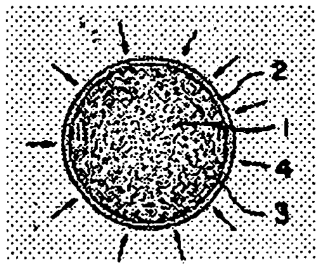

Figure 1

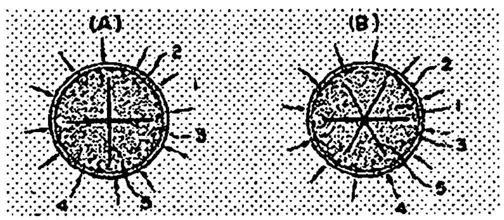

Figure 2

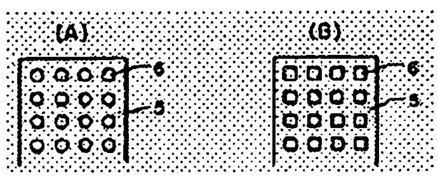

Figure 3